Debris Management Overview

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Introduction

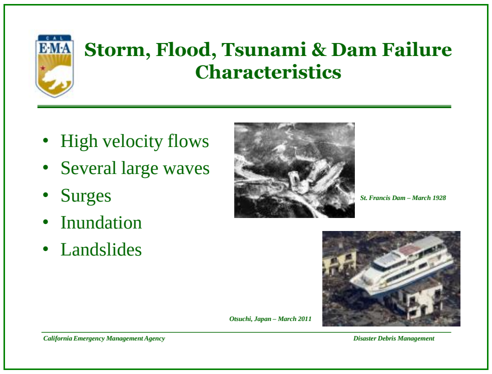
Disaster debris management costs average out to be 40% of the total cost of any given disaster. Since 2003, disaster debris costs in California have totaled approximately $228.6 million.

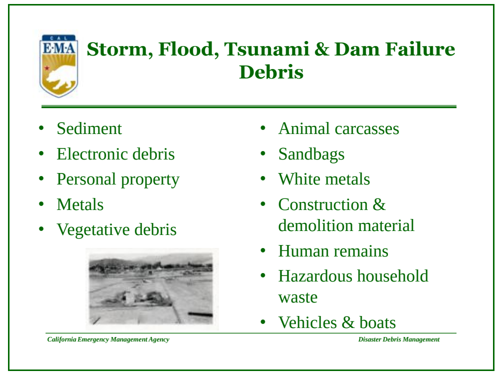
To effectively prepare for and respond to debris-related issues, it is necessary to have an understanding of the types of debris that are generated in the various disasters.

This section provides:

- Examples of typical disasters types and resulting debris.
- Examples of typical debris situations that may be encountered in actual disasters.
- Discussions of general issues that should be considered in debris planning and issues that have arisen in recent disasters and what we've learned.

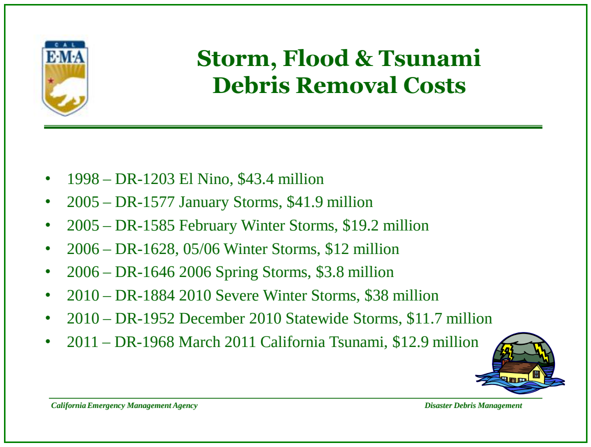
Disaster Type & Characteristics





Storms/Floods

- Characteristics:
  - High velocity flows
  - Inundation
  - Landslides
- Most areas of the country have experienced natural disasters in flooding – from the slow-rising expansive type seen in the Midwest to the flash flooding in the western and eastern mountain areas
- Structural damage may occur from flood saturation and from high velocity flow and forces from sediment transport
- Floods are often the most difficult disaster events relative to debris:
  - Often, all possessions are destroyed
    - Clothes, furniture, personal affects
    - Carpet, sheetrock, wood
  - Debris is put out for collection in waves for long periods of time
    - As water levels recede
    - Emotionally difficult to part with items
    - Some (particularly the elderly) may need assistance in moving objects
    - Delays due to homeowners waiting for Hazard Mitigation Grant Program (HMGP) buyout offers
- Secondary Impacts: Landslides, erosion of homes, facilities, roads, trees, and falling boulders



Storm Events

1998 – DR-1203 El Nino - $43.4 million
2005 – DR-1577 January Storms - $41.9 million
DR-1585 2005 February Winter Storms - $19.2 million
2006 – DR-1628 2005/06 Winter Storms - $12 million
DR-1646 2006 Spring Storms - $3.8 million
2010 – DR-1884 2010 Severe Winter Storms - $38 million
DR-1952 December 2010 Statewide Storms - $11.7 million
2011 – Spring Storms - $4.4 million

Tsunamis

Tsunamis are generated by earthquakes, volcanic eruptions and submarine landslides and usually in this order of frequency.

There are three destructive factors: inundation, wave impact on structures and erosion. Strong Tsunami induced currents lead to erosion of foundations and the collapse of bridges and seawalls. Flotation and drag forces move houses and overturn railroad cars. Considerable damage is caused from floating debris that becomes dangerous projectiles that crash into buildings; break power lines and starts fires. Fires from damaged ships in ports or from ruptured coastal oil storage tanks and refineries can cause damage greater that that inflicted directly by the tsunami. An increasing concern is the potential effect of tsunami draw down, when the receding waters uncover cooling water intakes of nuclear power plants.

- The 1964 Alaska Earthquake, magnitude 8.4, caused areas to be lifted as much as 50 feet in certain areas, while others greatly subsided. In addition, many local tsunamis generated within Prince William Sound created a Pacific-wide tsunami. This caused:
  - Destruction occurred in southeastern Alaska, in Vancouver Island, Washington, California and Hawaii
  - Killed 120 people
  - $106 million in damages
  - In Crescent City, CA, the waves reached more that 21 feet, destroyed half the waterfront businesses and 11 people were killed
  - Santa Cruz Harbor waves reached 11 feet causing some damage

  - Extensive damage in San Francisco Bay, Marin County marinas and at Noyo Harbor (Fort Bragg), Los Angeles and Long Beach harbors
  - California's loses were estimated to be between $1.5 and $2.3 (1964 dollars) million, while Crescent City damage was estimated at over $7.4 million

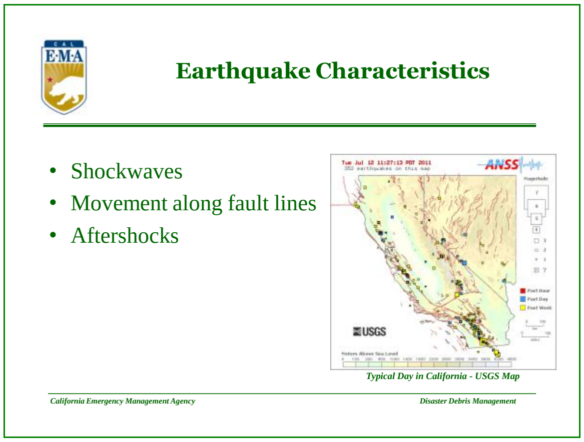
Other Notable Tsunami Events

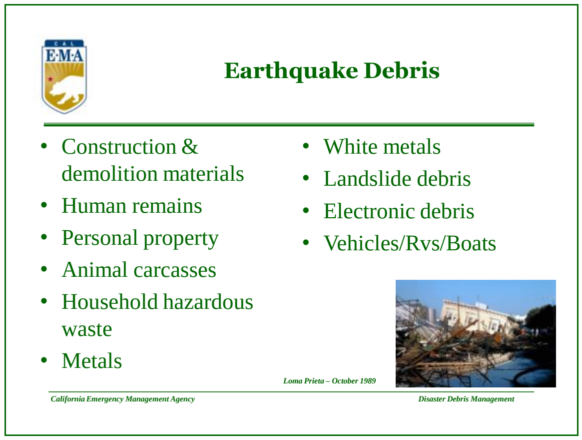
- 1700 – Crescent City, Lagoon Creek Orick, Cascadia subduction zone EQ - paleotsunami deposits.
- 1868 – San Francisco, Santa Cruz, Sacramento, 7.0 EQ on Hayward fault – 19 foot surge on shore at Cliff House, wave observed in Sacramento River and water seen rushing up river in Santa Cruz.
- 1883 – Sausalito, Krakatau Volcano – air pressure wave recorded on marigram.
- 2004 – Several coastal areas affected, Sumatran EQ – waves over 1 foot recorded on marigram. $4.4 billion in total damages
- 2011 – Japan Tsunami
  - California - $50.7 million in total damages, $12.9 million of this for debris removal
  - Hawaii – Estimated $30 million in total damages
  - Oregon – Estimated $6.6 million in total damages

Dam Failure

There have been a total of 45 recorded dam failures in California. Failures have occurred for a variety of reasons, the most common failure being overtopping. Other dams have failed due to specific shortcomings in the dam itself or an inadequate assessment of the surrounding geomorphologic characteristics. The first notable dam failure occurred in 1858 in Sierra County, while the most recent failure occurred in 1965. The greatest catastrophe relating to California dam failures was William Mulholland's infamous St. Francis Dam, which failed in 1928. Overall, there have been a least 460 deaths from dam failures in California.

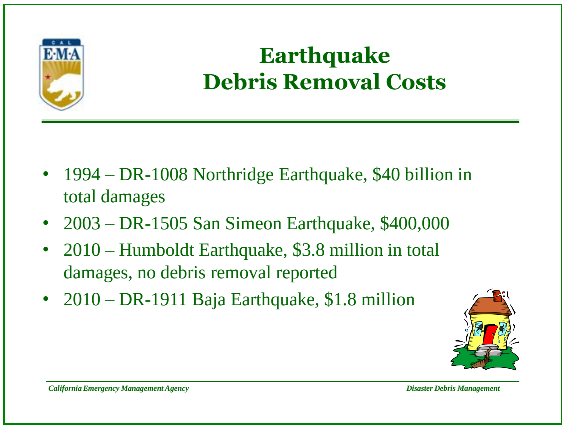
Disaster Type Characteristics – Cont'd





Earthquakes

- Characteristics:
  - Shockwaves
  - Movement along fault lines
  - Aftershocks
- Although relatively infrequent compared to the other disaster types, the effects are usually devastating
- Most large earthquakes occur on the west coast, but other areas of the country are also prone to earthquakes, less common but more dangerous due to ground accelerations traveling farther and due to ill-prepared structures
- Damages include:
  - Building and infrastructure damage
  - Damage to equipment and personal property from collapsed walls and roofs
  - Sediment from earthquake induced landslides
- USACE estimates that a major earthquake in the LA Basin could generate up to 147 million tons of debris

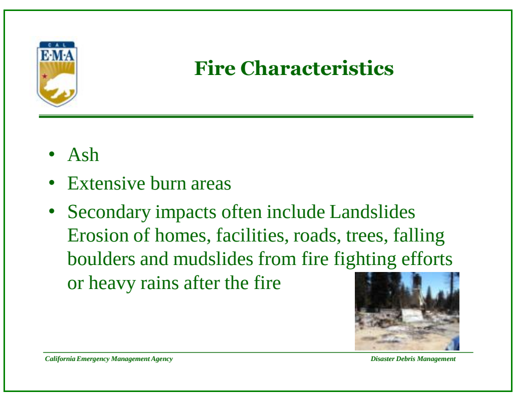


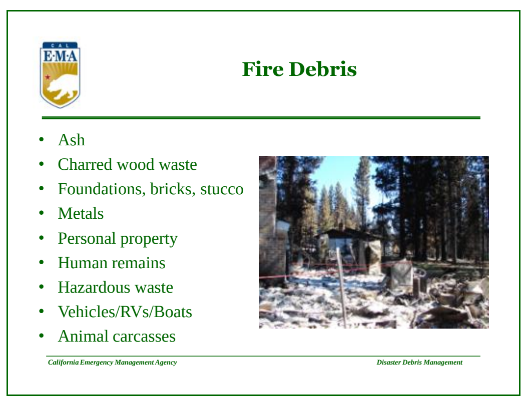
Notable Earthquake Events

- 1994 Northridge Earthquake - $40 billion in total damages, 57 people died, over 100,000 structures destroyed.
- 2003 San Simeon Earthquake - debris from was minimal. It cost approximately $400,000 for debris removal from this disaster.
- 2010 Haiti Earthquake - $14 billion in total damages for this event.
- 2010 – Humboldt Earthquake - $48 million in total damages, $12.5 million in debris costs for this event.

Note: After the Northridge earthquake, a retired deputy director for a California city department of public works indicated that the city had an excellent earthquake response with the exception that they did not consider the initial debris clearance in their plans (to remove debris out of the roads). The presence of debris significantly impeded the movement of the emergency traffic.

Disaster Type Characteristics – Cont'd

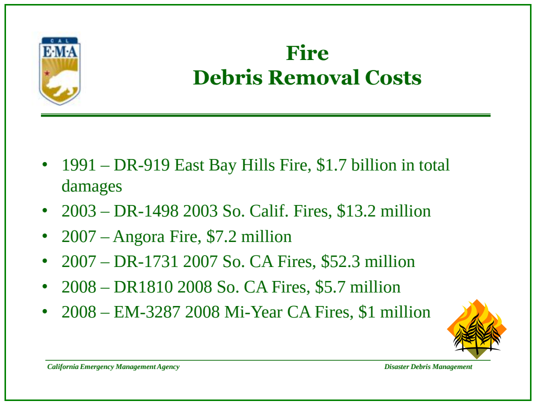




Fire

- Characteristics:
  - Extensive burn area
- Damages resulting from fires include:
  - Loss of vegetation
  - Damaged homes and buildings

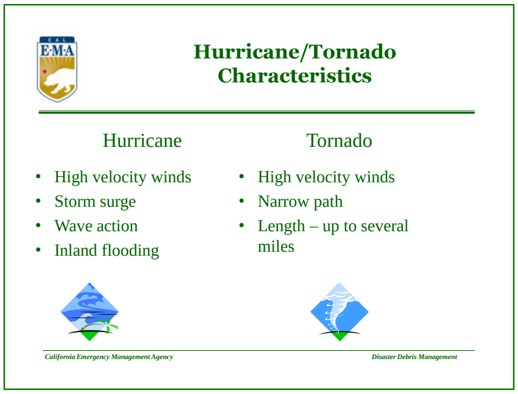
  - o Landslides and mudslides on burnt slopes when rains follow the fire
- Fires can produce a significant amount of debris with the increase of houses in woodlands
- Secondary Impacts: landslides, erosion of homes, facilities, roads, trees, falling boulders and mudslides from firefighting efforts or heavy rains after the fire.

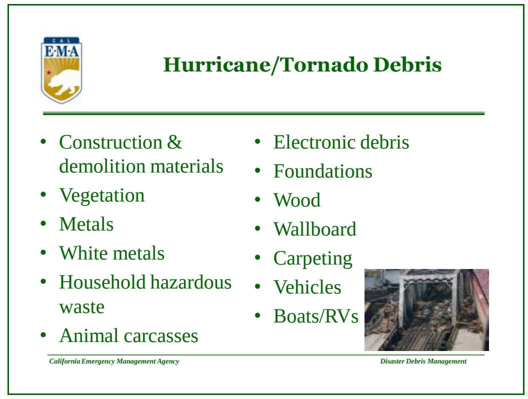


Notable Fire Events

- 1991 – East Bay Hills Fire – 354 homes & 456 apartments were destroyed, 25 people died, damages costs were approximately $1.7 billion.
- 2003 – Southern California Wildfires – 3, 616 structures destroyed, 21 people died, debris costs were approximately $13.2 million.
- 2007 – Angora Fire – 276 structures destroyed, debris costs were $7.2 million.
- 2007 – Southern California Fires - 2700 structures destroyed, 9 people died, debris costs approximately $1.7 million.
- 2008 Southern California Fires – 864 homes destroyed, debris costs approximately $5.7 million.
- 2008 Mid-Year California Fires (Lightning Complex) – 470 homes destroyed, debris costs approximately $1 million.

Disaster Type Characteristics – Cont'd





Hurricane/Tornado

High winds and sudden gusts are the typical cause of damage. This can include, but is not limited to:

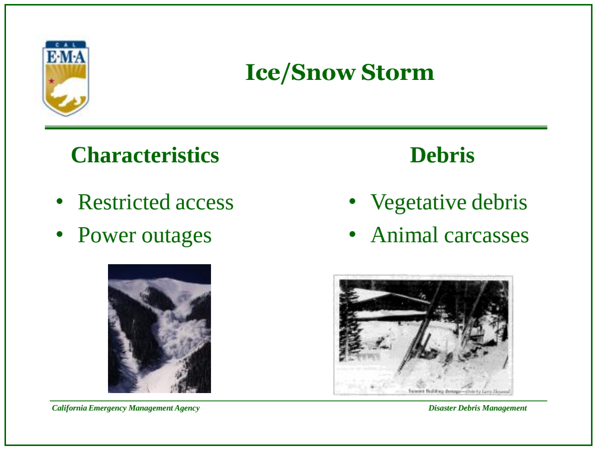
- trees
- roofs
- downed power lines

California does not, as a rule, have much experience with hurricanes or tornados but they are by no means rare events. From 1950 through 2004 there were 303 documented tornadoes in California. In addition, since 1993, there have been 57 waterspouts in the state's coastal waters. California averages six tornadoes and 5 waterspouts a year. In 2005 there were 20 tornadoes, including 12 in Sacramento County – more that the Oklahoma City metro area for that year.

While 80% of the state's tornadoes are weak, (F-0 or F-1), there have been a number of them occurring in populated areas. Los Angeles County ranks as the tornado capitol for the state with 41 tornadoes, five of these were ranked as an F-2. Orange County had 28 and almost as many waterspouts.

In addition, high winds along coastal areas can result in storm surges and wave action that may cause damage and flooding. This can lead to sediment deposits and debris associated with flooding.

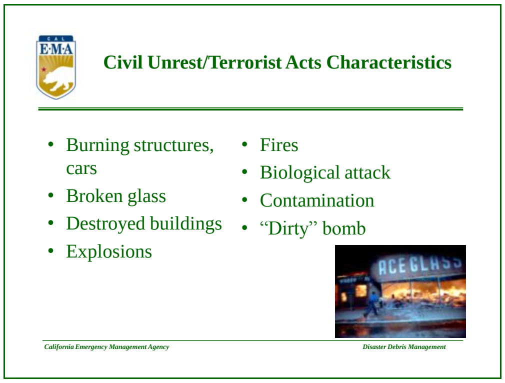
Disaster Type Characteristics – Cont'd

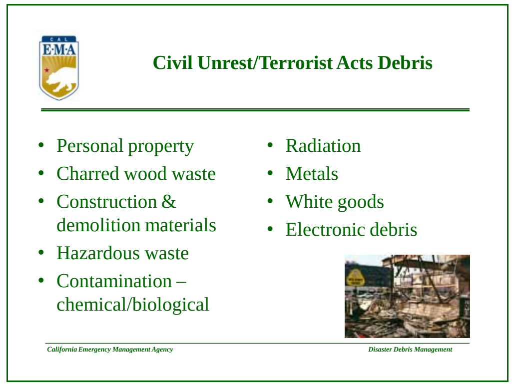


Ice/Snow Storms

- Characteristics:
  - Restricted access
  - Power outages
- Ice storms & severe snowstorms often cause similar problems as hurricanes
  - Significant damage to vegetation
  - Travel is difficult – roads may be closed as a result of fallen trees and limbs
  - Power is disrupted and not easily repairable – utility poles and wires may be severely damaged and become debris
  - Continued cold weather may impede restoration of utilities
  - Combined with snow accumulation and rapid warming, flooding may occur
- Communities susceptible to ice storms must plan for extensive vegetative debris removal and reduction

Disaster Type Characteristics – Cont'd





Civil Unrest/Terrorist Act

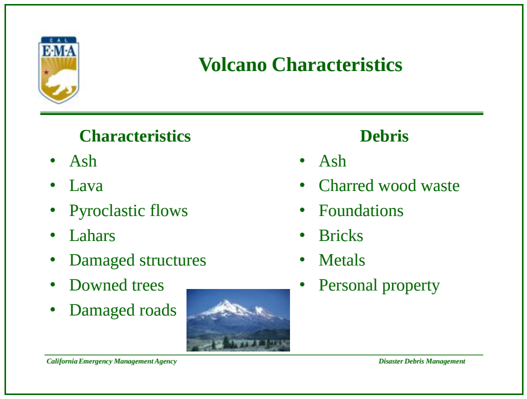
These two events have similar characteristics and debris, but usually occur for different reasons.

- Civil Unrest Characteristics:
  - Burning structures, cars
  - Broken glass
  - Destroyed buildings
    - Usually spontaneous
    - Can quickly get out of hand
    - Starts at one location and spreads out
    - Emergency responders often become targets
    - Crime scene investigation can become necessary
- Terrorist Act Characteristics:
  - Explosions
  - Fire
  - Chemical/Biological Attack
  - Contamination
  - "Dirty" Bomb
    - Little or no warning
    - Usually high-risk targets (government sites, airports, popular landmarks, utilities, cyber-space, postal service, nuclear plants)
    - Emergency responders often become targets
    - Crime scene investigation can become necessary
- Secondary Impacts: Flooding from fire fighting efforts

Notable Civil Unrest Events

- 1992 Los Angeles Civil Unrest - three days of disorder killed 55 people, injured almost 2,000, led to 7,000 arrests, and caused nearly $1 billion in property damage, including the burnings of nearly 4,000 buildings.

Disaster Type Characteristics – Cont'd



Volcano

- Characteristics:
  - Ash
  - Molten Rock
  - Damaged Structure
  - Downed Trees
- Secondary impacts: Earthquakes, landslides, erosion of homes, facilities, roads, trees, falling boulders and mudslides from fire fighting efforts or heavy rains after the fires

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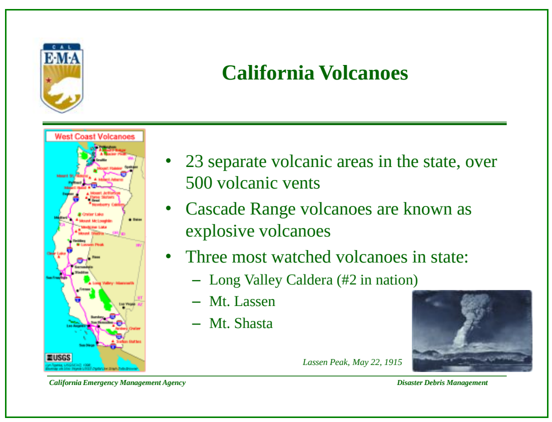


California Volcanoes

Within the State of California, 23 separate volcanic areas and more than 500 volcanic vents have been identified. California volcanoes demonstrate great variety in their types and in their geologic settings; potential volcanic hazards within the State vary accordingly. Therefore it is safe to say, that a volcano in California will erupt again.

The tectonic settings of volcanic centers range from subduction-related volcanism in the northern part of the State (Mount Shasta and Lassen Peak), to volcanism related to crustal stretching and thinning along the Sierra Nevada escarpment (Mono-Inyo volcanoes and Long Valley caldera), to volcanism in an area of active crustal spreading in the Salton trough (Salton Buttes rhyolite domes). Past eruptions within the State have run the gamut from small basaltic eruptions through catastrophic caldera-forming eruptions of rhyolite such as the one that formed the Bishop Tuff (Long Valley Caldera) about 700,000 years ago; virtually every known type of eruptive activity has occurred within California.

In 1973, a very conservative estimate indicated that losses in California due to volcanic eruptions could amount to $50 million. The results of the 1980 Mount St. Helens eruptions, however, suggest that far greater losses are likely from even small future eruptions in California. Eruptions of Mount St. Helens in May and June 1980, that were small in volume relative to possible future events in California, resulted in estimated short-term losses to the economy of Washington State of $970 million.

Debris from a volcano is often the cause of damage in and of itself. A debris avalanche is a sudden and very rapid movement of a mass of rock and soil mobilized by gravity. The debris flows in a dry or wet state and commonly originates in massive rockslides. A debris avalanche that occurred at Mount Shasta between about 300,000 and 360,000 years ago traveled more than 32 miles from the summit of the volcano, covered more than 243 square miles, and had a volume of at least 56,700 cubic yards. The Mount Shasta debris-avalanche deposit covers roughly 10 times the volume of the Mount St. Helens avalanche deposit.

Active Volcanic Areas

Mount Shasta – Mount Shasta has erupted, on the average, at least once per 800 years during the last 10,000 years, and about once per 600 years during the last 4,500 years. The last known eruption occurred about 200 years ago. Most of these eruptions produced large mudflows, many of which reached more than 30 miles from Mount Shasta. Future eruptions like those of the past could endanger the communities of Weed, Mount Shasta, McCloud, and Dunsmuir, located at or near the base of Mount Shasta.

Lassen Peak – 1914-1917: a series of small explosions that began on May 30, 1914, was followed 12 months later by extrusion of lava from the summit and a destructive pyroclastic flow and lahars on May 21, 1915. The fall of fine ash was reported as far away as Elko Nevada, more than 800 miles east of Lassen Peak. Intermittent eruptions of variable intensity continued until about the middle of 1917.

Areas of high relief within the Lassen volcanic center such as the Lassen Peak dome could also collapse and generate rock falls and/or debris avalanches that could endanger areas within about 16 miles of the source.

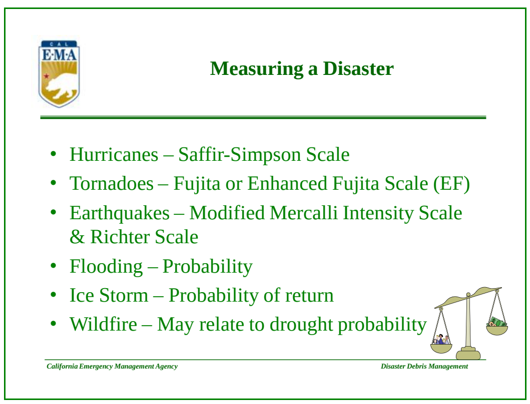
Long Valley Caldera - All but three of the 20 or so eruptions over the past 5,000 years have been explosive in nature. Those three were of the effusive, Hawaiian type (the Red Cones eruptions south of Mammoth Mountain about 5,000 year ago, the Negit Island eruption about 2,000 years ago, and the Paoha Island eruption just 250 years ago). All have been small to moderate in scale. In 1990, it was noted that trees in an area of about 170 acres have been killed by carbon dioxide (CO_2) emissions. Today concentrations of CO_2 are so high, that children and pets should not enter any natural collapse pits nor dig up loose material from the pits. Also in winter, CO_2 levels can develop in tree wells, around buildings and immediately below the snow in these high emission areas.

Clear Lake and Sonoma volcanics - Are the less-than-5-million-year old components of a northwesterly youngling line of volcanic. All these volcanics lie within the San Andreas fault system, which appears to have provided magma access to the surface. These volcanics are among the closest to a subduction plate boundary of any in the world and will repay closer tectonic investigation. Apparently leakage of basalts along the San Andreas Fault system has occurred repeatedly.

Medicine Lake - A sleeping giant, is the largest volcano in the Cascade Range. Filling up the entire southern skyline, it has been erupting off and on for half a million years. The eruptions were gentle rather than explosive like Mount St. Helens, coating the volcano's sides with flow after flow of basaltic lava. This created a shield-shaped mountain approximately 150 miles around the base and 7900 feet high. Medicine Lake is part of the old caldera, a bowl-shaped depression in the mountain. It is believed that the Medicine Lake volcano is unique, having many small magma chambers rather than one large one.

Coso Volcanic Field - It is well known as a geothermal area. A multi-disciplinary program of geothermal assessment carried out in the 1970s defined a potential resource of 650 megawatts electric with a nominal life span of 30 years. Commercial development beginning in the 1980's resulted in the startup of a geothermal steam-driven 3-MW electric power plant in 1987. Highway 395 crosses the west side of Coso volcanic field at the village of Little Lake, approximately 34 kilometers north of Inyokern, California. Most of the field is a few to several kilometers to the east, within the China Lake Naval Weapons Center.

Disaster Intensity Scales



Disaster Intensity Scales have been developed for hurricanes, tornadoes and earthquakes that relate the intensity of an event to the anticipated type and magnitude of damage.

Saffir-Simpson Hurricane Scale

The Saffir-Simpson Hurricane Scale is a 1-5 rating based on the hurricane's present intensity. This is used to give an estimate of the potential property damage and flooding expected along the coast from a hurricane landfall. Wind speed is the determining factor in the scale, as storm surge values are highly dependent on the slope of the continental shelf in the landfall region. All winds are using the U.S. 1-minute average.

- Category 1 hurricane has lighter winds compared to storms in higher categories. A Category 4 hurricane would have winds between 131 and 155 mph and, on average, would usually expected to cause 100 times the damage of a Category 1 storm.
- Depending on the circumstances, less intense storms may still be strong enough to produce damage, particularly in areas that have not prepared in advance.
- Hurricane-force winds can easily destroy poorly constructed buildings and mobile homes. Debris such as signs, roofing material, and small items left outside become flying missiles in hurricanes. Extensive

damage to trees, towers, water and underground utility lines (from uprooted trees), and fallen poles cause considerable disruption.
- High-rise buildings are also vulnerable to hurricane-force winds, particularly at the higher levels since wind speed tends to increase with height. It is not uncommon for high-rise buildings to suffer a great deal of damage due to windows being blown out. Consequently, the areas around these buildings can be very dangerous.

Fujita Tornado Scale

The Fujita Tornado Scale is a scale of wind *damage* intensity in which wind speeds are inferred from an analysis of the damage from the wind.

- Tornadoes are one of nature's most violent storms. In an average year, about 1,000 tornadoes are reported across the United States, resulting in 80 deaths and over 1,500 injuries. A tornado is a violently rotating column of air extending from a thunderstorm to the ground. The most violent tornadoes are capable of tremendous destruction with wind speeds of 250 mph or more. Damage paths can be in excess of one mile wide and 50 miles long.
- Tornadoes come in all shapes and sizes and can occur anywhere in the U.S. at any time of the year. In the southern states, peak tornado season is March through May, while peak months in the northern states are during the summer.
- Most tornadoes spawned by tropical cyclones are relatively weak (F0-F1), but more than 20% have been F2 or F3 and have caused considerable damage. Ten percent of all hurricane deaths are caused by tornadoes.

Enhanced Fujita Scale

In 1992, Dr. T. Theodore Fujita recognized that improvement was necessary. He updated the Fujita Tornado Scale to include an estimate of f-scale damage, thus the creation of the EF Scale.

The Enhanced F-scale still is a set of wind estimates (not measurements) based on damage. Its uses three-second gusts estimated at the point of damage based on a judgment of 8 levels of damage to the 28 indicators. These estimates vary with height and exposure. **Important**: The 3 second gust is not the same wind as in standard surface observations. Standard measurements are taken by weather stations in open exposures, using a directly measured, "one minute mile" speed.

Modified Mercalli Intensity Scale

The Mercalli Scale is based on observable earthquake damage. From a scientific standpoint, the Richter scale is based on seismic records while the Mercalli is based on observable data, which can be subjective. Thus, the Richter scale is considered scientifically more objective and therefore more accurate. For example a level I-V on the Mercalli scale would represent a small amount of observable damage. At this level doors would rattle, dishes break and weak or poor plaster would crack. As the level rises toward the larger numbers, the amount of damage increases considerably.

The Mercalli Scale is a scale of 12 increasing levels of intensity and ranges from imperceptible to catastrophic destruction. It is an arbitrary ranking (not mathematical) based on observed effects after an earthquake has occurred. Lower numbers generally deal with the manner in which people feel the earthquake. Higher numbers are based upon observed structural damage.

Richter Scale

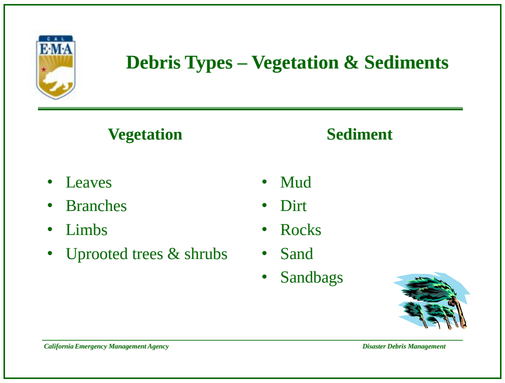
The Richter Scale is not used to express damage but to express energy release. It is a mathematical equation that is determined from the logarithm of the amplitude of waves recorded by seismographs. The magnitude is then expressed in whole numbers and decimal fractions. Each whole number step in the scale corresponds to the release of about 31 times more energy than the amount associated with the preceding whole number.

Other Disaster Types

Other disaster types also have some measure of intensity:

- Flooding: Normally identified by probability. For example, reference to a 100-year flood represents a 1% probability of occurring in any one year.
- Ice Storms: Less defined but some areas do maintain records on return periods.
- Wildfires: Difficult to affix a scale but some relate wildfire potential to drought probability or available fuel.

Debris Types and Issues



As indicated earlier, many of the debris types will be generated by more than one disaster type, however, the magnitude and mix of the debris will vary between disasters.

Vegetation

- Trees.
- Brush.
- Limbs.
- Vegetative debris will be generated from most disaster types.
  - Hurricanes and Tornadoes - significant quantities.
  - Floods.
  - Wildfires.
  - Ice Storms – some of the largest amounts of vegetative debris come from ice storms.
- Vegetative debris quantities.
  - May run as high as 70% of the total amount of disaster debris – as with Hurricane Floyd in North Carolina in 1999.

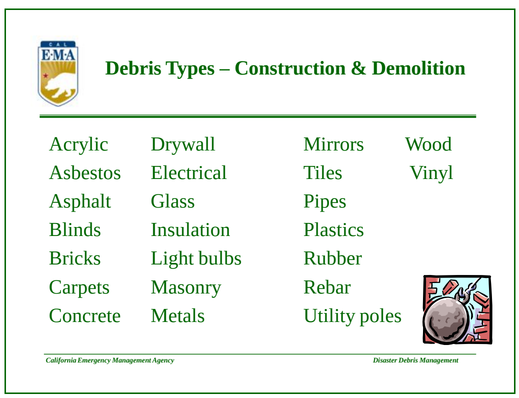
- Vegetative debris will be found both on public and private property, and will be found within streets, often blocking vehicle traffic.
  - o Debris within streets must be cleared quickly to allow movement of emergency vehicles.

Sediment

- Sediment and sand will result primarily from flooding events (floods and hurricanes).
  - o Areas with unconsolidated or loose soil material may become almost a river of sediment during flood conditions.
  - o Sediment flow conditions can be highly destructive and dangerous.
- Wildfires and earthquakes may also generate landslides and mudslides, resulting in the deposits of sand and rocks.
- Sediment flow combined with high velocity floodwater may cause extensive structural damage – both the sediment and structural debris will require disposal.

  Note: Sandbags (Sediment) used to protect against flooding remain after floods recede must be handled cautiously – they can be contaminated with pollutants from flooded sewage treatment plants, pesticides, herbicides, chemicals and hydrocarbons. The sandbags must be tested and disposed of properly.

Debris Types and Issues – Cont'd



Construction and Demolition (C&D)

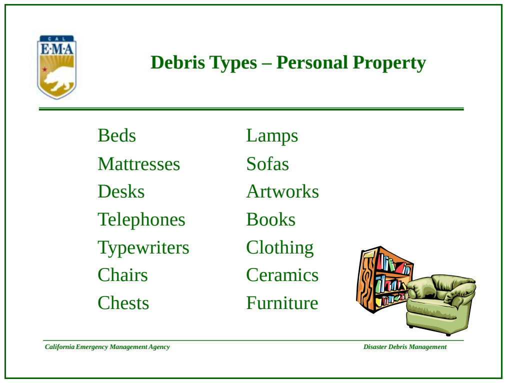
C&D debris is generated by damaged structures and can be present in most types of disasters to varying degrees (hurricanes, tornadoes, floods and earthquakes).

- C&D materials may include both building construction materials and contents (office equipment, personal property, etc.).
- Some C&D materials can be recycled but most will require disposal.
- The structure's use and building materials must be evaluated to consider the potential presence of asbestos and other potentially hazardous materials.

Utility Systems

- In addition to building damage, construction debris may include utility systems such as utility poles, wiring, conduits and other items from power, telephone, Cable TV and other utilities.
    - These damages should be expected in all types of disasters, with a significant concentration from ice storms.
    - It is necessary to coordinate closely with appropriate utility companies to define jurisdictional responsibilities and to encourage cooperation to expedite recovery.
- Charred wood and construction materials are a significant portion of wildfire debris, and may also result from earthquake or other disaster induced fires.
- Charred materials may require different handling and disposal.
    - Resulting materials are often a mix of the building construction materials and contents, including asbestos and other hazardous material, but their presence may not be readily identifiable.
    - Burned asphalt often is included in this mix.
    - Must look at the method of disposal to determine how various possible components of this mix may be accounted for and paid for.
- Even if removal is the responsibility of the private landowner, the local community must consider its disposal.
- Destroyed homes will result in significant quantities of debris – C&D and contents. Building materials blown into roadways and yards may include lumber, shingles and other building materials.
- Local ordinances should require homeowners to have their private contractors haul any debris resulting from the demolition and/or rebuilding process to be taken directly to the landfill and should be paid for from insurance proceeds, when available.
- This will result in large quantities of mixed debris.
    - Debris becomes mixed by:
        - Uncontrolled collection and disposal.
        - Disaster effects such as high winds from hurricanes and tornadoes.
    - Roadside debris piles often contain a mixture of debris types.
    - Separation of the mixed debris is often not cost effective. Most often the debris is taken directly to the landfill.
- The metal frames, light metal porches and outbuildings may be suitable for metal recycling efforts.

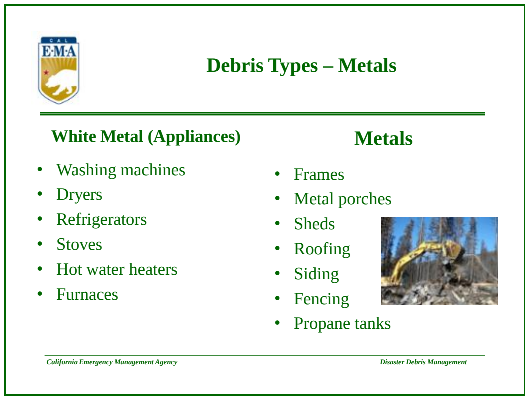
Debris Types and Issues – Cont'd



Personal Property

- Household furnishings and personal effects will become debris as a result of many disaster types.
    - Hurricanes and Tornadoes from wind damaged residences.
    - Flood effects after the water recede.
    - Earthquakes from damaged structures.
    - Wildfires from burnt homes and structures.
- If residents do not have sufficient time to move contents, as would be the case in tornadoes, flash floods and earthquakes, the quantities of personal effects will be significant.
- Quantities increase when roofs are damaged during rain events.
- Household furnishings normally makeup the second wave of debris that will come to the right-of-way.
- Rugs, furniture, and mattresses should be treated as mixed debris and taken directly to a landfill.
- White goods, such as refrigerators, stoves, washers, dryers, etc. should be segregated and recycled if possible. Care must be exercised to ensure that Freon is removed from cooling units by a certified air-conditioning technician.
- Removal of vehicles and boats should be the owner's responsibility to remove and dispose of.

Debris Types and Issues – Cont'd



White Metals (Appliances)

White metals may include:

- Refrigerators.
- Freezers.
- Washers.
- Dryers.
- Care must be exercised to ensure that Freon is removed from cooling units of refrigerators, freezers and air conditioners; experts should do this.

Metals

- Metals debris may include:
  - Roofing.
  - Mobile homes.
- Some metals might be suitable for recycling.

Debris Types and Issues – Cont'd

Household Hazardous Waste

Household hazardous waste (HHW) is usually the stuff that's kept under the sink, in the garage and/or shed.

- HHW can result for any type of disaster that results in damage to a residence.
- HHW may be mixed in with personal property debris.
- Every effort should be made to segregate HHW from the debris stream at the curbside, as these materials require special handling and disposal.
- HHW includes such items as:
  - Paint.
  - Solvents.
  - Cleaning supplies.
  - Insecticides.
  - Pool chemicals.
  - Propane tanks.
  - Gasoline.
  - Oils.

Hazardous Waste

- Use experts for removal, transportation & disposal.

Human Remains

The remains of many people are unaccounted for and many are still trapped in the rubble. Recovery of human remains in a dignified and respectful manner must be integrated with the debris stream processing. Remains should be recovered at the rubble site to the maximum extent practical. However, human remains may be encountered either at the disaster debris collection point or at a debris processing / staging site where transported debris is separated and processed. It should be noted that animal remains pose similar health hazards, and that the same safety and health requirements should be applied as appropriate when handling animal remains. More information can be found in Appendix A – USACE Human Remains handling.

Crime Scene Debris Removal

It is essential for public safety, and for purposes of crime scene investigation that the site of a terrorist incident is secured during the initial response, and maintained during the recovery operation. Local governments must establish methods to be utilized at a crime scene that focus on law enforcement concerns such as site security and the safeguarding of evidence. The early response phase of a critical incident must prioritize public safety and responder safety. The scene and the evidentiary possibilities must be safeguarded while simultaneously protecting the health and safety to the public and to the first responders.

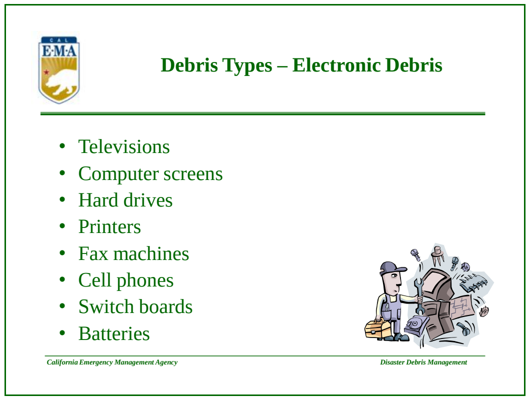
See Appendix B for a document prepared by the federal Department of Homeland Security. It was created from interviews conducted with personnel who responded to the Alfred P. Murrah Federal Building Attack, including FBI, Oklahoma City, OK Fire Department, and State of Oklahoma Division of Emergency Management. March 9-10, 2005. While the emphasis of this section is focused on a Weapon of Mass Destruction (WMD) incident, it is applicable to other terrorist events where debris is part of a criminal investigation.

Animal Carcasses

It should be noted that animal remains pose similar health hazards found in the recovery of human remains, and that the same safety and health requirements should be applied as appropriate when handling animal remains.

- Often times, a storm will cause a farmer to not have access to the animals, which can cause additional deaths.
- Farmers and/or animal owners should be responsible for the disposal of their animals, but when large numbers of animals are affected, it may be beyond the means of the farmer to properly dispose of the animals.
- Additionally, particularly in floods, animals may have washed into trees and onto public and private property. To determine ownership of these animals would often be impossible.
- In large-scale events, wild animals could also be a problem for collection as well as disposal.
- Disposal of animals presents an environmental/health issue.
    - The health and safety of those doing the cleanup as well as the citizens at large must be considered.
    - Long-term environmental impacts of its disposal must be considered.
    - The traditional method for disposal is burying. However, for large numbers, this may present a health issue. Composting and incineration are also effective means of disposal, but must be evaluated against environmental regulations. (See CalRecycle website for further information.)

Debris Types and Issues – Cont'd

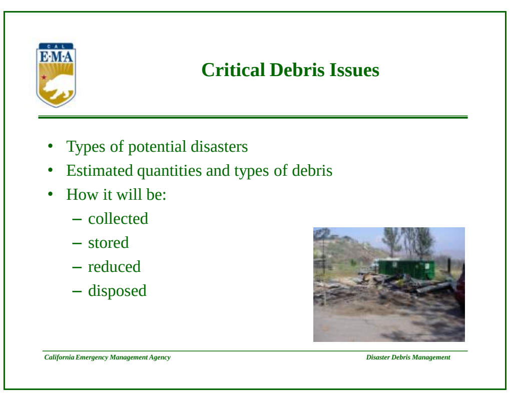


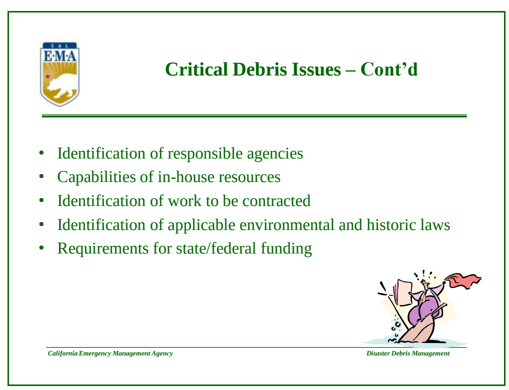
Electronic Debris

Electronic debris will result from many disaster types. In the past, batteries from radios, cell phones, flashlights, etc., were tossed into the waste stream without pause. Today, this and other types of electronic debris are pulled out and disposed separately. In fact, many landfills charge an additional fee for this debris type.

- If residents do not have sufficient time to move, as would be the case in of fires, earthquakes, flooding, tornadoes, the quantities of electronic debris could be significant.
- Is usually mixed in with personal property and C&D debris.
- Care should be exercised with this debris as some building materials are hazardous Electronic debris should be separated and disposed of in designated landfills.

Critical Debris Issues





To effectively manage debris activities, it is important to identify and address critical debris issues, including:

- What type of disasters should be planned for in this community?
- How much and what types of debris can be generated in these events?
- How will the material be collected, stored, reduced and disposed of?

Additionally, the community must identify how the work will be organized, performed and managed.

- Identify agencies available to assist in the debris efforts and what their responsibilities will be.
- Identify the capabilities of in-house resources and how they can best be used.
- Identify the types of work that should be contracted.
- What types of contracts will be most appropriate for the type of work?
  - Identify the Federal, State and local environmental and historic preservation laws that might apply to the anticipated work.
  - Identify the types of documentation that may be required to support state/federal funding.
- Consider state/federal requirements for public assistance funding.